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Market Risk Analysis of Electrolux Group Company by Applying the CorporateMetrics Methodology

Analýza tržního rizika společnosti Electrolux Group aplikací metodologie CorporateMetrics

Student: Bc. Lanhui Tu

Supervisor of the diploma thesis: doc. Ing. Miroslav Čulík, Ph.D.

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1. Introduction
2. Description of the CorporateMetrics Methodology
3. Characterization of Electrolux Group Company
4. Market Risk Analysis by Applying the CorporateMetrics Methodology
5. Conclusion

Bibliography
List of Abbreviations
Declaration of Utilisation of Results from the Diploma Thesis
List of Annexes
Annexes

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Ing. Iveta Ratmanová, Ph.D.
Head of Department

prof. Dr. Ing. Zdeněk Zmeškal
Dean

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涂瀾慧 Tu Lanhui

Student's name and surname

Content

1. Introduction

In general, the company faces many risks, and company applies many ways to make market risk measurement. The company tries to formalize quantification of the influence of market rate volatility on a company's financial results, such as earnings or cash flow. It can make the company clearly understand the risks and impacts for the company. The company can make some management to control and reduce the volatility of financial results.

The main objective is to apply the CorporateMetrics methodology to predict the probability distribution of net operating income of Electrolux Group in 2019.

The thesis is divided into five parts.

The first part is introduction. The chapter 2 mainly introduce the CorporateMetrics Methodology, which includes the financial model which is used in the application part. Some method of prediction will be introduced. the principle and calculation process of method will be described.

The chapter 3 includes the introduction of the selected company, Electrolux Group. It includes the business and financial position of company. Then it contains SWOT analysis of company. In the introduction, it explains the risk which the company met.

The chapter 4 is about the application of the CorporateMetrics Methodology. Based on the financial statement, income statement, it explains the procedure and calculation of probability distribution of the net operating income in 2019. And finally, it can be used for the sensitivity analysis of probability distribution of the net operating income in case of changing in two key exchange rates.

The chapter 5 is calculation, it includes the summarize of whole thesis.

2. Description of the CorporateMetrics Methodology

In this part, the main goal is to introduce the CorporateMetrics methodology, and understand the principle of some financial models. This part also includes some introduction of simple average method. And then we can know the process of the calculation according to the principle of prediction.

2.1 Introduction of CorporateMetrics

CorporateMetrics is a framework that it can deal with the unique market risk management needs of corporations. In the CorporateMetrics, it measures the market risk which the corporate meet in the entire environment. There are some basic components of the CorporateMetrics, which include the definition and the method of measurement of risk.

In the document, the definition of CorporateMetrics[1] is that a comprehensive package of definitions, methodologies, data sets, and software for measuring market risk in the corporate environment. On the one hand, CorporateMetrics focus on two corporate financial results, which are earnings and cash flow of company, these two financial results can influence, and they can be used to make the measurement of the value of the company. On the other hand, for the company, CorporateMetrics also can be used to predict of earnings and cash flow which the prediction is based on a range of different projected market rates, such as foreign exchange rates, interest rates, commodity prices, and equity prices. From the resulting range of prediction, Market risk measures can be obtained.

2.1.1 Main features of CorporateMetrics

In the CorporateMetrics, we measure the market risk in the corporate environment. By corporate environment, we refer to a setting that focuses on a company's shareholder value and on some important corporate financial results such as earnings and cash flow. We focus on the revenue which the corporate earns, and we

[1] CorporateMetrics: LEE, Alvin Y. *CorporateMetrics Technical Document [online]*. New York: RiskMetrics Group, J. P. Morgan, 1999. [2017-08-04]

need to be based on the income statement and the cash flow statement. According to corporate-level analysis, it is not only applied for non-financial institutions, but also financial institution, which has trading business.

Compared with the corporate environment, the financial environment is different, which means that the focus is on the market value of financial instrument portfolio. However, the company is also interested in the market value of the environment portfolio. For example, the value of a portfolio of cash investments and hedging transactions.

In the corporate environment, there are many factors that will affect the company's future earnings prospects. The uncertainty of company's basic business will cause the uncertainty in future earnings and cash flow. For example, the uncertainty of the company's sales volume will directly lead to the uncertainty of earnings of the company. And many market risks can also lead to uncertainty about the company's future earnings and cash flow.

There are some corporate risks which the company meet, which include business risk, market risk, credit risk and operational risk.

In the market risks faced by the company, market risk also can come from a variety of factors, including foreign exchange risk, interest rate risk, commodity price sensitive income or expenditure, pension liabilities and stock option plans and other market risks.

For the market risks, many companies have implemented specific sensitivity analyses to predict the impact of specific market changes on financial results. However, what we need to pay attention to is that the CorporateMetrics framework is specifically targeted at the market risk of the entire company. CorporateMetrics does not address other risk types such as credit and operational risk.

2.1.2 Procedure of CorporateMetrics methodology

CorporateMetrics has been already mentioned in the previous section. In the application of CorporateMetrics methodology, the procedure can be divided into five basic steps.

The first step is to metric specification, for the objective of the company, the

company need to specify and measure the financial result of the company, such as the earnings or cash flow of company, and then the company specifies the time horizons and the confidence level for the risk measurement which the assumption need to be made.

The second step is to make exposure mapping. According to the first step, we have specified the metric, for the target company, we need to analyze and identify the basic components of the earnings or cash flow and find the components which are affected by market rates. We need to observe their changes and analyze how it is affected by market rates. In a word, the exposures are related to market rates by analyzing how the value of each exposure, and each exposure is affected by each market rate.

The third step is scenario generation. The process is to generate a large number of scenarios and make the graph, which shows, the different possible values for a given series of market rates as time goes on. In the first step, we have already specified the horizon, and then, for each horizon, we need to specify a probability distribution of the relative market rates which have been mentioned in the second step. And then we generate each scenario according to sampling the value of each distribution and make the graph with the values over time. In the scenario generation, each scenario is independent, and an individual scenario shows a unique path that the market rates can take over the specified horizon.

The forth step is valuation. It is important to calculate the future financial results, earnings or cash flow, which we specified in the first step, and get the result with each scenario of market rate.

The fifth step is risk measure computation. We can get some results with some scenarios and analyze the results. And then we make the graph with the distribution of the financial results,

This is the entire forecasting process. Which is the procedure for measuring market risk and prediction of the financial results. From the procedure of CorporateMetrics methodology, what we finally get is not an individual value, it has many values and the number of its values depends on the number of series which we generated in the third step.

The company can get the benefit from the application of CorporateMetrics methodology. On the one hand, the company can formalize quantification of the influence of market rate volatility on a company's financial results, such as earnings or cash flow. It can make the company clearly understand the risks and impacts for the company. On the other hand, the company can understand the risk, and make some management, it is helpful to get some information to control and reduce earnings volatility.

2.1.3 Corporate sensitivity analysis

Company usually analyze the impact of market risks. Sensitivity analysis is a common approach in corporate budget planning. According to the specific market rate, the company analyze the influence and predict some situation. Sensitivity analysis can be used to prediction of the financial result in “worst case” or “downside case”. For example, an organization wants to predict the revenues of its foreign subsidiaries in case of the potential depreciation of the national currency. In different condition of market, there are different results. Sensitivity analysis can get some information of the probability of the situation occurring which is difficult to evaluate.

Whatever, they can reflect or cannot reflect the full various potential results.

Compared with sensitive analysis, CorporateMetrics methodology can offer a broader approach which can be applied for the measurement of some market risks of company.

By using probability distributions of market rate for multiple asset classes, which is a basis, a company can create and generate many situation with different market rate scenarios. These situations can reflect a full range of probability of the financial results with market rates. In addition, company can create the scenarios which is used to reflect some specific assumptions about the relationship between different market rates. It can be based on the current information of market.

Scenarios can be developed from long-horizon forecasting techniques based on current market information. Compared with sensitivity analysis, CorporateMetrics methodology can provide more comprehensive analysis of market rates measurements for the company.

2.2 Prediction method of application

From the application of Corporate Metrics methodology, financial model is helpful to calculation and prediction for the practical application part. The financial model includes the Geometric Brownian model and Vasicek model. It is related to probability distribution.

2.2.1 Probability distribution

Probability distribution is mainly used to express law of the probability of the value of random variables. People use probability distribution for convenience, the probability distribution takes different representations depending on the type of the random variable.

The principle of probability distribution is based on the feature of test. When certain conditions are met, there are many possible outcomes. It is impossible to predict which outcome will occur beforehand; if it just observes one or a few or trials, the results are contingent and uncertain. However, under the same conditions, when a large number of repeated tests are carried out, the test results show some specific regularity, it is frequency stability, which is usually called the statistical regularity of random phenomena.

There are some special types of probability distribution, such as normal probability distribution and standard normal distribution. The normal distribution is a very important probability distribution of continuous random variables. There are many variables in biological phenomena that obey or follow a normal distribution. Many statistical analysis methods are based on a normal distribution.

There is an important probability distribution, standard normal distribution. The standard normal distribution is the simplest form in a normal distribution, and any normal distribution can be calculated as a standard normal distribution. It is widely used by people.

In general, the normal distribution can be expressed by the probability density function.

$$f(x|\,\mu,\sigma^2) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \tag{2.1}$$

In the formula, μ is the mean of the distribution, σ is the standard deviation, σ^2 is the variance.

In general, the standard normal distribution can be described by the probability density function.

$$\varphi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} \tag{2.2}$$

It is special case of normal distribution, in this case, the mean value is 0, the standard deviation is 1.

2.2.2 Geometric Brownian model

Geometric Brownian model is similar with Monte Carlo model, the model is one of financial model. It is a popular and simple way of computational algorithms that rely on repeated random sampling to obtain numerical results[2]. The basic idea of this model is to generate and use random numbers to solve problems that may be determined in principle.

In principle, the Monte Carlo method can be used to solve any problem which has a probabilistic interpretation. According to the law of large numbers, the integral described by the expected value of a random variable can be approximated by taking the empirical mean, which is also called the sample mean, of the independent samples of the variables.

The central idea is to design a sensible Markov chain model with a defined stationary probability distribution. That is, in this limitation, the samples generated by the MCMC method will be samples from the desired distribution. Approximate static distribution through empirical measurements of the stochastic state of the MCMC sampler. The assumption of this model follows the Markov process, for example, the future prices or future exchange rates are affected by the present price and the present exchange rate.

The Geometric Brownian motion[3] is very similar with the arithmetic Brownian

[2] Monte Carlo model: https://en.wikipedia.org/wiki/Monte_Carlo_method
[3] Geometric Brownian motion ZMEŠKAL, Z., D. DLUHOŠOVÁ and T. TICHÝ. Financial Models. 1st ed. Ostrava: VSB-Technical University of Ostrava, 2004. ISBN 80-248-0754-8.

motion. The arithmetic Brownian motion is defined by

$$dx = \mu \cdot dt + \sigma \cdot dz \tag{2.3}$$

In the formula, z is a random variable from the standard normal distribution. Which the mean value is 0, the standard deviation is 1.

On the surface, this is the special case of the Ito process, for which the parameters are constant and independent on other variables. The assumption is straightforward, the item which is estimated has a linear trend.

Similarly, the geometric Brownian motion, can be defined by.

$$dx = \mu \cdot x \cdot dt + \sigma \cdot x \cdot dz \tag{2.4}$$

In the formula, it is similar with the formula of arithmetic Brownian motion, and we can change the form of formula to make a same form with the arithmetic Brownian motion. And we can get new formula.

$$\frac{\mathrm{dx}}{x} = \mu \cdot dt + \sigma \cdot dz \tag{2.5}$$

In the formula, we need to know some relative parameters. μ is the mean value, and σ is the standard deviation.

The most important type of geometric Brownian motion is the one of formula which has been mentioned applied on the continuous returns.

$$S_T = S \cdot e^{\mu} \tag{2.6}$$

From the formula, we can get the continuous return, therefore the continuous return μ follows the formula.

$$\mu = \ln \frac{S_T}{S} \tag{2.7}$$

In the calculation, we can get continuous return through calculating the logarithm of relative change. From the formula, it can be shown that for the function G gives.

$$dG = d\ln S = \alpha \cdot dt + \sigma \cdot dz \tag{2.8}$$

In the formula, α refers to the average return, commonly per annum, and the standard deviation σ is also commonly per annum. And from the formula, we have to

calculate the average return α.

$$\alpha = \mu - \frac{\sigma^2}{2} \tag{2.9}$$

From the formula, we can find that its logarithm is distributed normally although the price S is lognormally distributed. In the process of prediction, it can be formulated by the geometric Brownian motion. According to some formula, we can calculate some relative values.

The random evolution can be formulated by

$$S_t = S_{t-1} \cdot exp\left(\alpha \cdot \Delta t + \sigma \cdot \tilde{z} \cdot \sqrt{\Delta t}\right) \tag{2.10}$$

The mean value can be formulated by

$$\mathrm{E}(S_T) = S_0 \cdot exp(\mu \cdot \Delta t \cdot n) = S_0 \cdot exp(\mu \cdot T) \tag{2.11}$$

The quantile for the lognormal probability distribution can be formulated by

$$S_T^{\gamma} = S_0 \cdot exp\left(\alpha \cdot \Delta t \cdot n + \phi^{-1}(\gamma) \cdot \sigma \cdot \sqrt{\Delta t \cdot n}\right) \tag{2.12}$$

In the above three formulas, S_t is the value at time t. Δt is the length of each interval. n is the number of steps. $\phi^{-1}(\gamma)$ is the γ-quantile from the standard normal distribution. Here $d\tilde{z}$ is random component, with $d\tilde{z} = \tilde{z} \cdot \sqrt{\Delta t}$, and $\tilde{z}$ is a random value from the standard normal distribution N (0;1).

From the principle of geometric Brownian motion, we can know the procedure of prediction. When we apply the financial model to predict the exchange rate, we need to calculate the relative parameters, such as the continuous return, the average value and standard deviation.

In general, we can generate 1000 different independent scenarios. At first, we need to generate random numbers, we can apply a whole range procedure with various degrees of complexity and accuracy, we generate the random values from the standard normal distribution for each scenario. After a series of calculations, we will get 1000 different target values which also are a series of random numbers.

When the geometric Brownian motion is used in evolution, we need to notice that the expected returns of geometric Brownian motion are independent of the process, on the one hand, because the estimated value is based on the random values which

follow the standard normal distribution, the value which we evaluate has an error with the actual value. On the other hand, the process of evolution is simple and easy to calculate. The assumption of the geometric Brownian motion includes that the value which we use are positive values.

2.2.3 Vasicek model

The geometric Brownian motion usually are applied to stocks, it cannot be used to generate the evolution of interest rates, since for interest rates in longer time horizons average (equilibrium). Therefore, we can use some other financial model to evaluate this kind of value. They are called mean-reverting processes, they are one type of stochastic process.

This type of stochastic process has a characteristic, these models usually consist, besides others, of two essential parameters. The first one describes the long-run average of interest rates, the second one the velocity of the mean-reversion (haw fast is the reversion to the mean). These processes include also the specific Wiener process. This type model contains Vasicek model.

Vasicek model[4] is a type of financial model, it is a one-factor short-term interest rate model because it describes interest rate changes driven by only one market risk factor.

In general, the basic model for one time period which we usually use can be formulated by

$$r_t = r_{t-1} + a \cdot (b - r_{t-1}) \cdot \Delta t + \sigma \cdot \sqrt{\Delta t} \cdot \tilde{z} \tag{2.13}$$

This is a general form of expression. And when the model is used, we can divide the random estimate of the model in to two part, the trend and the residual deviation. Therefore, the sum of these two items can get the whole model. The general estimated model for interest rate can be formulated.

$$\Delta r = \Delta \hat{r} + \varepsilon \tag{2.14}$$

In the formula, Δr is the random increment of returns, $\Delta \hat{r}$ is the estimated trend

[4] Vasicek model is from ZMEŠKAL, Z., D. DLUHOŠOVÁ and T. TICHÝ. Financial Models. 1st ed. Ostrava: VSB-Technical University of Ostrava, 2004. ISBN 80-248-0754-8.

of the statistical model. The other one ε is a residual deviation. These are all corresponding to the previous theory.

Combined with the previous two formulas, the estimated discrete mean-reversion Vasicek model can expressed as.

$$\Delta r = \Delta\hat{r} + \varepsilon = a \cdot (b - r_{t-1}) \cdot \Delta t + \hat{\sigma} \cdot \sqrt{\Delta t} \cdot \tilde{z} \tag{2.15}$$

In this formula, there are some parameters, *a* and *b* are estimated parameters, the $\hat{\sigma}$ is the estimated standard deviation. Δt is the length of each interval, and $\tilde{z}$ is a random variable which follow the standard normal distribution N (0;1).

The next step is to apply the least square method, we transform the origin mean-reversion model into a linear one, estimate its parameters and then we recalculate parameters of the original model.

$$\Delta \mathrm{r} = \hat{\alpha} + \hat{\beta} \cdot r_{t-1} + \varepsilon \tag{2.16}$$

Combined with formula (2.15), the formula (2.16) has some new parameters, $\hat{\alpha}$ and $\hat{\beta}$.

$$\hat{\alpha} = a \cdot b \cdot \Delta t \tag{2.17}$$

$$\hat{\beta} = a \cdot \Delta t \tag{2.18}$$

From the formula (2.16), we have to calculate some relative parameters, such as $\hat{\alpha}$ and $\hat{\beta}$ in the linear model, *a* and *b* in the origin model. And them we can generate 1000 independent random values which will be used in Excel, the *Random Number Generation*. Based on the basic formula, we have to calculate some relative parameters in two models.

$$a = -\frac{\hat{\beta}}{\Delta t} \tag{2.19}$$

$$\mathrm{b} = \frac{\hat{\alpha}/\hat{a}}{\Delta t} \tag{2.20}$$

$$\sigma = \frac{\hat{\sigma}}{\sqrt{\Delta t}} = \frac{\sqrt{\frac{1}{N}\sum_t \varepsilon_t^2}}{\sqrt{\Delta t}} \tag{2.21}$$

According to a series of calculations, we need to calculate the random increment of returns, and the trend with some relative parameters. We need to statistical estimate

the linear model (2.14), and we apply the Excel module *Regression*, including the verification of the statistical significance of particular parameters and the entire model by the t-test and the F-test.

Corresponding to the above, we have to generate 1000 different independent scenarios. And finally, we can get 1000 values in the evolution.

The Vasicek model is one model which can capture mean reversion, and it can respect an empirical fact that the interest rates regularly revert to the long-run mean b, with the velocity a. The interest rates fluctuate within a limited range. In the application of Vasicek model, the disadvantage is that the interest rates can be negative value, however, in reality, the interest rate cannot be negative values. The property is rather unrealistic.

Based on the principle of the geometric Brownian motion and Vasicek model, the evolution of the exchange rate can be made, we can apply the model to predict the exchange rate in the next period.

2.2.4 Simple average method

The simple average method is also one of the commonly used methods for evolution of some items. And according to the method, we can predict some financial values in the future.

The simple averaging method uses the average number of historical data to calculate for a certain observation period. Simple average method is a method of determining a predicted value based on an average of historical value. In general, the simple average method can be divided into several types according to process of calculation, such as arithmetic averaging method, geometric averaging method, and weighted averaging method.

In the principle of simple average method, it refers to dividing the sum value of past data by the total number of data points, and the we can obtain the arithmetic mean, which is the predicted value. This method of prediction is simple. When the predicted object changes little and there is no obvious trend, this method can be used for short-term prediction.

In general, the calculation is very simple, the formula of simple average method

can be expressed by.

$$\mathrm{I}_e = \frac{\sum_{t=1}^{n} I_t}{n} \tag{2.22}$$

Where I_e is the item which we have to predict, *n* means the whole period which we select, I_t means the specific value at the *t* period.

When we apply the simple average method for the financial items, in the simple averaging method, the issue price of the material is fixed at the average unit price. A simple average is an average price that does not take into account the quantity involved. The average price is calculated by dividing the total rate of material in the store by the amount of the price. The simple averaging method is a method of predicting the future sales volume by using a simple arithmetic mean of sales over the past few periods.

In practical applications, when the operating revenues and the quantity of product which has been sold of company already know, we can calculate the average piece at each period, and then we can get a series of average price of product. finally, we can calculate the average value which are expressed the price of product, which we are not necessary to calculate each price of each product. In the prediction of the financial item, we also can calculate the average value which is based on the item at the previous periods. The average value can be future value.

The advantages of simple average method are very easy to calculate, it is not necessary to consider other some complex factors. We can get the value fast which is expressed as the future value.

There are some disadvantages of simple average method. The method has not considered the specific volatility of the object, after the application of simple average method, the volatility of the predicted object is averaged, therefore it can not reflect the trend of the forecasting object. This method is only suitable for the forecasting object with less stable fluctuations of the stable enterprise, which the volatility of the estimated value will be stable and not large.

Compared with the simple average method, the weighted average method has a little difference. The assumption of simple average method is to calculate the average of the volatility, and the weight of the item which we estimated is same. However, in weighted average method, it focuses on that the weight of the object item at each period

is different.

In the principle of weighted average method, the weighted average method uses the past observations of the same variable arranged in chronological order and uses the chronological number which has been arranged as the weight to calculate the weighted arithmetic mean of the observed value, which is used as the predicted value of the variable in the future period. The weighted average method is a trend forecasting method.

In general, the weighted average method can be simply expressed by the formula below.

$$\frac{\sum_{i=1}^{n} w_i * x_i}{\sum_{i=1}^{n} w_i} \tag{2.23}$$

In the formula, *n* means the whole number which we select, *W* means the weight of the object value. According to the formula, we can calculate the predicted value as the future value.

In the practical application, the weighted average method can be used in the prediction of some financial items. On the one hand, the weighted average method may calculate the weighted average unit price of the inventory in the current period based on the quantity and amount of the inventory at the beginning of the period and the quantity and amount of the inventory deposited in the current period, as the price of the inventory issued at the beginning of the period and the inventory at the end of the period. The actual cost of issuing inventory in the current period is calculated at one time. On the other hand, the method can be used in the prediction of fixed items. When some expenses or costs are independent with revenues, or they are independent of the number of products sold, we can set some weight for the items, and we can calculate the weighted average value based on the historical data, which can be used as the predict value in the next period.

The advantages of weighted average method are also easy to calculate, it is not necessary to consider other some complex factors. When it used in the calculation of average unit cost of product, the calculated cost is averaged, and the allocation of inventory costs is compromised.

The disadvantage of weighted average method is not conducive to the timeliness

of accounting, in the calculation of average unit cost of product, the ending inventory value calculated by the weighted average unit price is significantly different from the current cost, in the case of a large price change. Compared with the simple average method, it considered that the weight of the object value at different periods and set different weighted and calculate the average.

Based on the simple average method, it has a disadvantage that the error is possible to be relative larger. And we can change the item, however, the basic idea of the simple average method is not changed. The basic idea of new method is to calculate the annual growth rate of the historical data, and then we need to calculate the average value of annual growth rate, which used as the predict annual growth rate. Based on the new annual growth rate which we estimated, at final, we can calculate the object value in the next period.

In general, the annual growth rate of S can be calculated according to the formula.

$$K = \frac{S_t - S_{t-1}}{S_{t-1}} \tag{2.24}$$

In the formula, we have to get the object value at the t period and the previous period. According to the formula, we can calculate the annual growth rate, which is expressed by K.

Based on the simple average method, we can calculate the average of annual growth rate, which can be expressed as the growth rate of the object value which we need to predict in the next period. At final, we can get the object value according to the transformed formula.

$$S_t = S_{t-1} \cdot (1 + K) \tag{2.25}$$

In the formula, we can calculate the object value according to the last value and the average growth rate which is calculated by the simple average method. Through this calculation, we can predict the value in the next period.

3. Characterization of Electrolux Group Company

In this part, the main aim is to introduce this company, Electrolux Group, and learn more about the financial situation of this company. It has been divided into four subsections. The first subsection is to introduce the company, the second subsection is to briefly introduce its financial situation according to financial statements, the third subsection is to understand and analyze the company according to SWOT analysis. The final subsection is to introduce the risk which is related to prediction of net operating income.

3.1 Overview of the Electrolux Group

Electrolux group which is often referred to as Electrolux, is a Swedish manufacturer of multinational appliances and the company is headquartered in Stockholm. The company continues to rank second in the global ranking of sales units in the global home appliance industry after Whirlpool, and the company ranks first in the global ranking of sales commercial laundry equipment sales.

Its products are sold under various brand names, mainly for white goods and vacuum cleaners for the mass consumer market. The company also produces professional electrical appliances.

Chart 3.1 Logo of Electrolux Group

Sources: https://www.electroluxgroup.com/en

Here is logo of Electrolux Group. It is very simple design. In the point of name of the company, in North America, Electrolux's name has long been used by vacuum cleaner manufacturer Aerus LLC, which was originally established to sell Swedish

Electrolux products. In 2000, Aerus transferred the trademark rights back to the Electrolux Group, and in 2004, he stopped using the name of Electrolux.

For Electrolux Group, the company is a global leader in household appliances and appliances for professional use. The company uses a good social environment to develop strategies. On the one hand, the main objective of the company is to focus on consumer-relevant product innovations to create a profitable growth and pay attention to produce the product which can provide the convenience for consumer to improve the consumer experience. On the other hand, the company invest in modular product architectures to further increase cost efficiency and flexibility in production. Their main aim is to provide a good experience for consumer.

In 1912, Electrolux founder, Elk Wenergreen, invented the world's first household vacuum cleaner. In 1919, the company was founded in Sweden, it was formed by the merger of Svenska Elektron AB and Elektromekaniska AB. and is headquartered in Stockholm. In 1923, the company acquired AB Arctic and subsequently added an absorption refrigerator to its product line. In 1925, the first domestic refrigerator was produced. Other appliances which the company produces soon appeared, including they produced washing machine in 1951, produced dishwasher in 1959, and produced food service equipment in 1962.

In the more than 70 years, Electrolux acquired and merged nearly 400 home appliance manufacturers and brands. In addition to traditional household appliances, it also involved commercial laundry service and catering facilities, garden equipment and the company became a professional home appliance manufacturer.

Through Electrolux brands, including Electrolux, AEG, Anova, Frigidaire, Westinghouse and Zanussi, the company sells about 60 million household and professional products in different markets every year.

The Electrolux Group operations are organized into six business areas. The business areas include within major appliance, in Europe, Middle East and Africa, North America and Latin America. The Electrolux Group's operations include products for consumers as well as professional users[5].

[5] Business areas of Electrolux is from www.electroluxgroup.com/annualreports/2018.

Electrolux Group produces a wide range of products. Products for consumers comprise major appliances, such as refrigerators, freezers, cookers, dryers, washing machines, dishwashers, room air-conditioners and microwave ovens. Floor-care products, water heaters, heat pumps, small domestic appliances as well as consumables, accessories and service are other important areas for Electrolux. Professional products comprise food-service equipment for hotels, restaurants and institutions, as well as laundry equipment for apartment-house laundry rooms, launderettes, hotels and other professional users and beverage products.

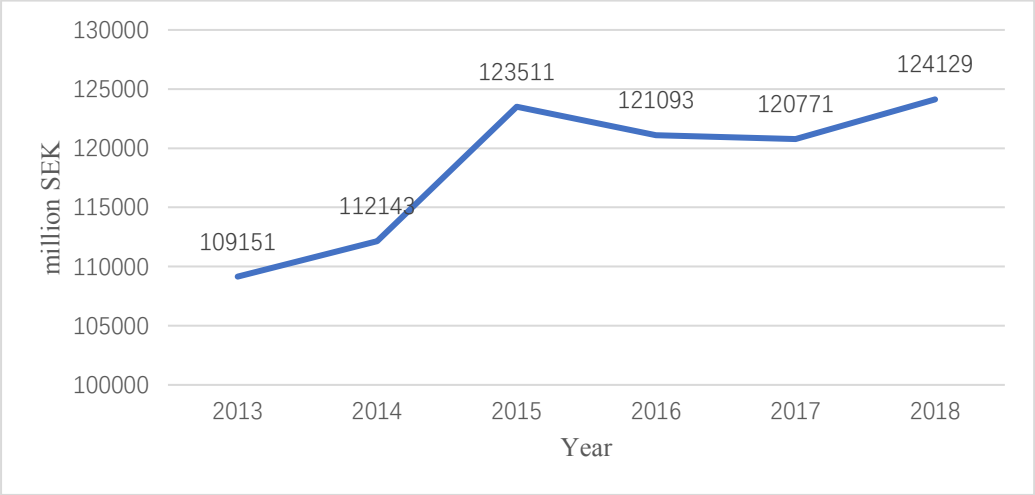
The company has 100,000 employees, there are 22 plants in Europe. In 2004, its sales exceeded 16 billion dollars, accounting for 25% of the world's home appliance market. Nowadays, there are many households that own or use Electrolux's home appliances.

3.2 Financial position of the Electrolux Group

In this part, we pay attention to analyze the company's economic situation in a simple and crude way. And we analyze some items which are used in the practical application part.

According to financial statement of the Electrolux Group, we can firstly analyze the net sales of the company. The specific data can be found in income statement of the company.

Chart 3.2 Net sales of Electrolux Group from 2013 to 2018 (Unit: million SEK)

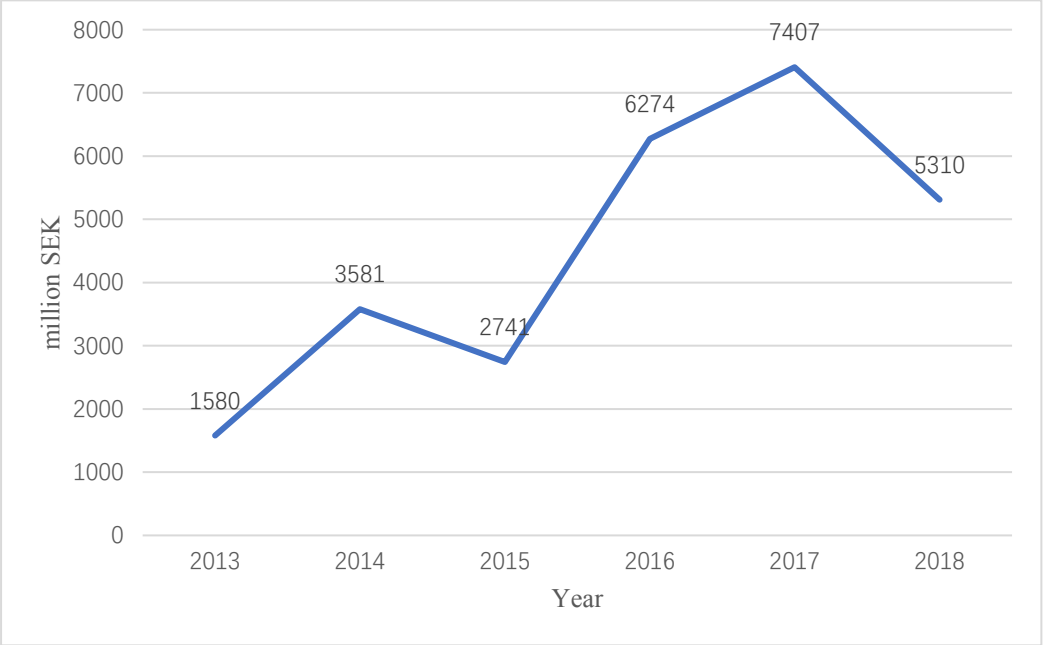


Source: *https://www.electroluxgroup.com/en/*

In the chart, we can find the tendency of net sales of the company from 2013 to 2018, it increased and then decreased a little, finally, it went up again. Because of some policy changed and external factor, net sales of the company decreased in 2016. From the tendency of the net sales, we can find the trend is growing up. In 2013, net sales of the company are 109151 million Swedish Krona, finally, the net sales of Electrolux Group have been reached 124129 million Swedish Krona in 2018. We can simply predict that its net sales will increase in the future. From this item, it means that the company has a good development, because they have a good sales strategy and good product which can provide a good experience for consumer.

We can find some information of net operating income in the past few years. This item is very important for our analysis, we will predict net operating income in 2019. Therefore, we can create the chart of net operating income of Electrolux Group in the past six years.

Chart 3.3 Net operating income of Electrolux Group from 2013 to 2018 (Unit: million Swedish Krona)



Source: https://www.electroluxgroup.com/en/

In the chart, we can find the tendency of net operating income of the company from 2013 to 2018, it increased and decreased in 2015 and 2018. Compared with net sales of the company, the value of net operating income is very small, because the

company has higher cost of goods sold which includes cost for production and sourced products, warranty, environmental fees, warehousing and transportation and exchange-rate changes on payables and receivables and the effects from currency hedging and selling expenses which include expenses for brand communication, sales driving communication and costs for sales and marketing staff and the cost for impairment of trade receivables. From the chart, it has two low point, in 2015, the operating expenses are higher, in 2018, the cost of good sold and selling expenses are higher than before. From the dotted line which represents its trend line, the line is increasing. Finally, we can simply predict that net operating income of Electrolux Group is possible to increase in the future.

In general, the company have a profitable growth in different market.

3.3 SWOT analysis of the Electrolux Group

SWOT analysis is a strategic planning technique used to identify strengths, weaknesses, opportunities, and threats for the company related to business competition or project planning. From the analysis, we can analyze the internal and external factors of the company.

In the point of strengths, Electrolux group focus on sustainability, sustainability is a key business driver, and profitable growth of the company is supported by a strong balance sheet and healthy cash flow generation. Combined with tendency of the global, the company focus on producing the green products which has not only increased their tolerance in many countries, but also increased the demand for commodities as the world's attention turned to environmental protection. It can prove that the company can continuous sales of products sell the product in different countries and guarantee its sales in different countries.

In the report, we can find that the company also makes continuous innovation in products. According to consumer demand, the company also focuses on manufacturing energy-efficient and environmentally friendly products to satisfy consumers. According to innovation of the product, it has a better advantage than other competitors, it can guarantee that the company can make a good share in the appliance markets. The company has a relatively mature and big company, it has created a strong relationship with the relative suppliers and partners of the company, which can help the

company develop in the appliance industry. It is more effectively than its competing company. The company sell the products in many markets and in many countries, which can help the company increase its visibility. And the exposure of the company in abroad market has significantly contributed to its sales of appliance and interaction with potential customers.

In the point of weaknesses, the company has low capacity use up to only 60%, on the one hand, from the analysis of net operating income and net sales in the past few years, we can find that the company's selling expenses and management costs are high, which can reduce the company's efficiency and profitability. On the other hand, the company provides door-to-door services for consumers, it makes their resources strained and undermining the reputation of the brand image. Services strategy selected by the company result in wasted resources, while other companies receive goods and services from vendors in stores and stores. The company products which are sold by Electrolux at low level, compared with other product which are produced by other appliance companies. It caused that the company's sales of Electrolux brand refrigerators are lower than sales of other product which customers purchase.

In the point of opportunities, the company operates in a fast-changing market and needs to adapt very quickly. And it can operate relatively well. The company can make an appropriate strategy and make the product innovation to adapt the environment of economy. The company has already met some criteria of low energy use and sustainability whereas governments in the near future will impose regulation. The company have created some market in many areas, middle class growth in Asia is an opportunity for labor. In this area, it has relatively more human resources than other areas. And it can provide human resources and the company can provide appropriate wage for employee. It can improve the utility and provide the efficiency for company. The company also can make the resource allocation, it is possible to make the company reduce the cost and use resources effectively.

In the point of threats, social threats for Electrolux Group can be the consumer demand for products, the consumer demand is the demand of the product which is convenient to use and energy efficiency. The company have to make some product innovation to meet the needs of consumer. On the one hand, Internet can also be a threat for the Electrolux Group, because the consumer can choose and purchase the product

according to the price and ability of product, it is possible to create the opportunity for their competitors. On the other hand, the company is relatively bigger than others, and sells products in different markets, it has a disadvantage that the company is hard to control, and the company respond and change in time when these markets change from time to time, it will impose the risk to the company and it is possible to make some loss for the company.

3.4 Foreign exchange rate risk of Electrolux Group

In this part, we make a simple introduction about the foreign exchange rate risk of the Electrolux Group, which is related to the next part to predict the net operating income in 2019.

From the business area, we find that the company have foreign exchange risk, the major net export currencies that Electrolux is exposed to are the U.S. dollar, and the euro. Therefore, changes in exchange rate SEK/EUR and exchange rate SEK/USD will influence the operating income. It refers to the influences of changes in foreign exchange-rates on the Group's income and equity. From the report, the changes in exchange-rates can influence the Group's operating income in connection with translation of income statements of the company into SEK. And Electrolux does not hedge such exposure.

From the 2018 annual report, changes in exchange rates had a negative impact of 896 million SEK on operating income year-over-year. The impact of transaction effects was –1,024 million SEK, it has a negative impact for the company. Translation effects amounted to 128 million SEK.

4. Market Risk Analysis by Applying the CorporateMetrics Methodology

In this chapter, the main objective is to apply the CorporateMetrics Methodology for the selected company, Electrolux Group. It is important part, which is devoted to the prediction of the net operating income based on the simulation of the two related factors according to stochastic model.

The major net export currencies that Electrolux is exposed to are the U.S. dollar, and the euro. They include the exchange rate SEK/EUR and exchange rate SEK/USD. The basic data is historical weekly data for the previous three years, from 2015 to 2018.

4.1 Exchange rate prediction

The first step is to input data and present the data graphically in order to analyze the trend of the graph. According to the historical weekly data, it is convenient to use models to predict weekly data for the next year.

Because the core markets of Electrolux Group are markets in Western Europe and America. Therefore, the exchange rate SEK/EUR and exchange rate SEK/USD are taken into account.

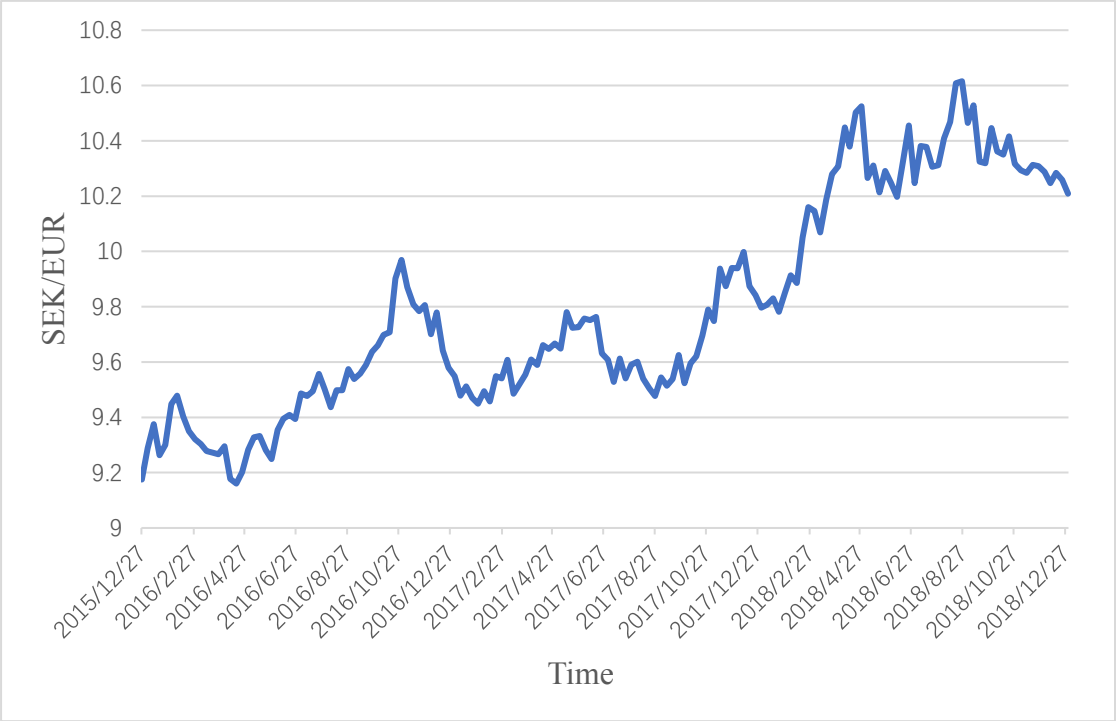
4.1.1 Exchange rate of SEK/EUR prediction

First, we analyze the historical weekly exchange rate SEK/EUR which is from 2016 to 2018. Then we can use one appropriate model to predict the exchange rate for the next year 2019.

4.1.1.1 Historical trend of exchange rate SEK/EUR

According to the situation, the data is from December 28, 2015 to December 30, 2018. The sample size is 158. And then, we can present the data graphically. Then we can get the result about the previous.

Chart 4.1 Historical weekly data of exchange rate SEK/EUR from December 28, 2015 to December 30, 2018



Source: https://www.investing.com/currencies/eur-sek-historical-data

From the Chart 4.1, we can get some information. From December 28, 2015 to December 30, 2018, the exchange rate has been volatility, not stable, it increased from December 28, 2015 and slightly decreased at two point, which are separately from October 30, 2016 and August 26, 2018. During this period, the maximum value is 10.6194, the minimum value is 9.1605.

From the trend point of view, it is increasing and slightly decreasing during this period. From the tendency, we can analyze the trend, the trend coefficient is 0.0011, it is positive, it is obvious to find that the overall trend of the exchange rate SEK/EUR is rising. The rising exchange rate means that Swedish Krona is appreciating for the euro.

According to the historical data, we can apply the Geometric Brownian Motion to prediction the exchange rate for the next year 2019.

4.1.1.2 Prediction of the exchange rate of SEK/EUR

According to the theoretical part, we should generate the random evolution of the exchange rate for some independent scenarios. Each part should be based on the

Geometric Brownian Motion.

We suppose the length of interval is 1. At first, we have to calculate the continuous return which is based on the historical exchange rate according to the formula of continuous return. Based on the reference of the formula (2.10), We can calculate some related parameters according to the formula of model. Finally, we can create the table.

Table 4.1 Related parameters for prediction

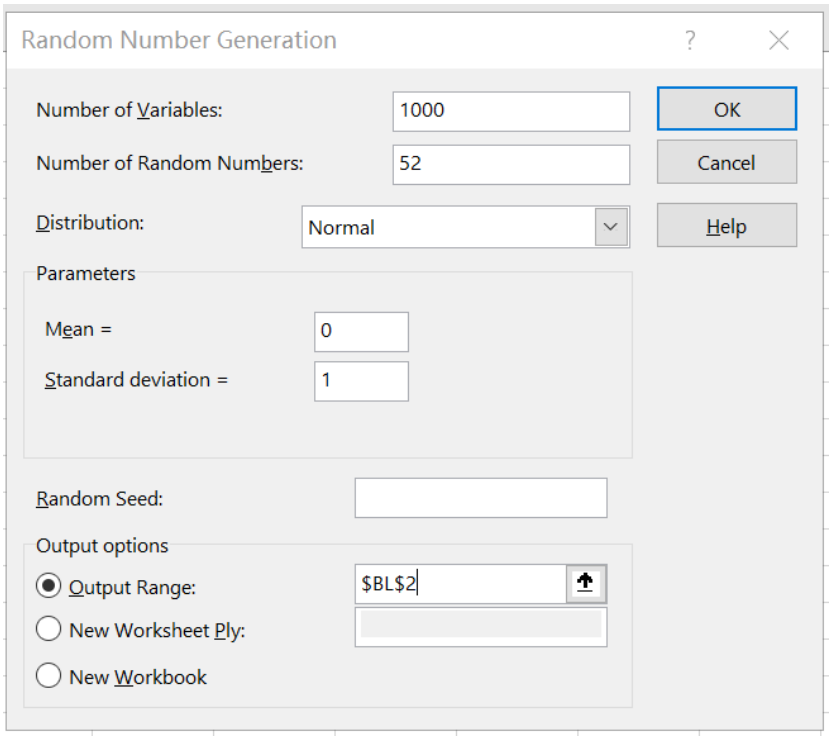
α (%)	σ (%)	Δt	E_0	N
0.065	0.77	1	10.2091	157

From the Table 4.1, the mean value α is 0.065%, standard deviation σ is 0.77%, the time interval Δt is 1, the initial exchange rate of SEK/EUR is 10.2091. the number of steps is 157. At Final, we can get the specific formula.

$$S_t = S_{t-1} \cdot exp(0.065\% + 0.77\% \cdot \tilde{z}) \tag{4.1}$$

We decided to generate 1000 scenarios. The next step is to generate random values $\tilde{z}$ from the standard normal distribution for each random scenario. The procedure can be done by the function in Excel. We should input the data.

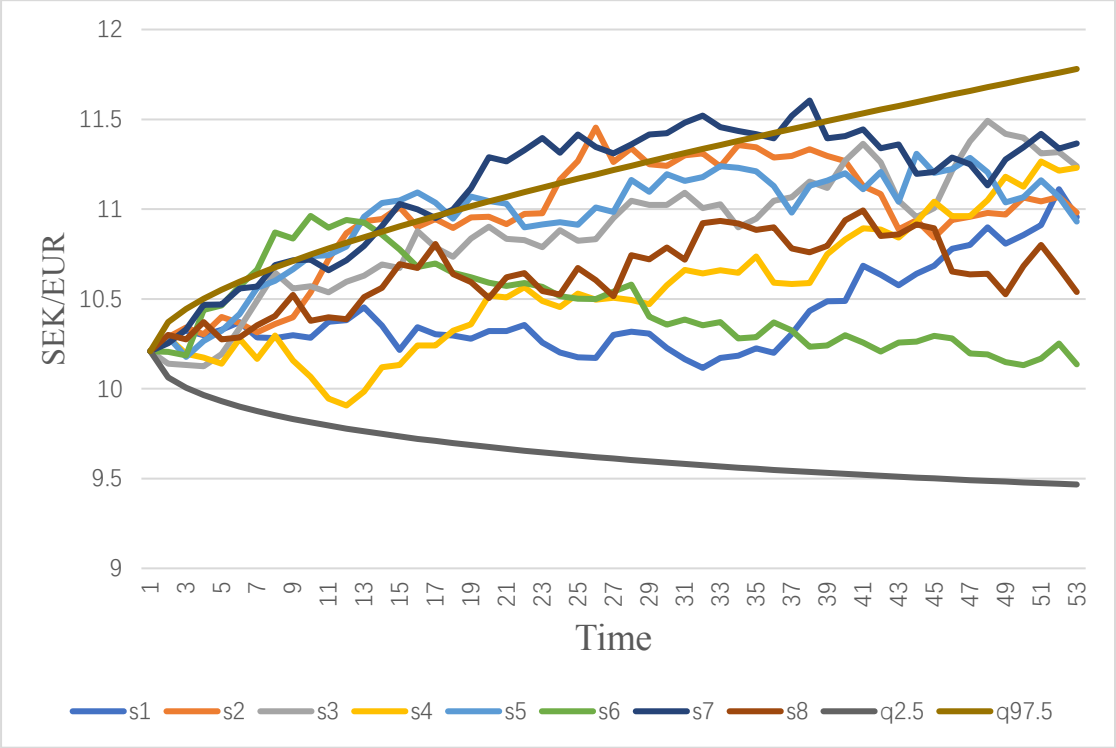
Figure 4.1 Specifying the Random Number Generation for standard normal distribution



From the figure 4.1, there are 1000 independent scenarios and 52 steps for each scenario. Then we use the relative formula (4.1). We can calculate the results.

And we have already generated 1000 independent scenarios for the exchange rate prediction. Finally, we can get the results of the exchange rate predictions.

Chart 4.2 Exchange rate SEK/EUR evolution in 2019



We just select the ten independent scenarios. The quantiles specify boundaries within which the exchange rate should randomly evolve. In the chart, the quantiles for the level of 2.5% and 97.5% have been shown. In the prediction, the exchange rate of SEK/EUR will be Based on data from the previous five years.

4.1.2 Exchange rate of SEK/USD prediction

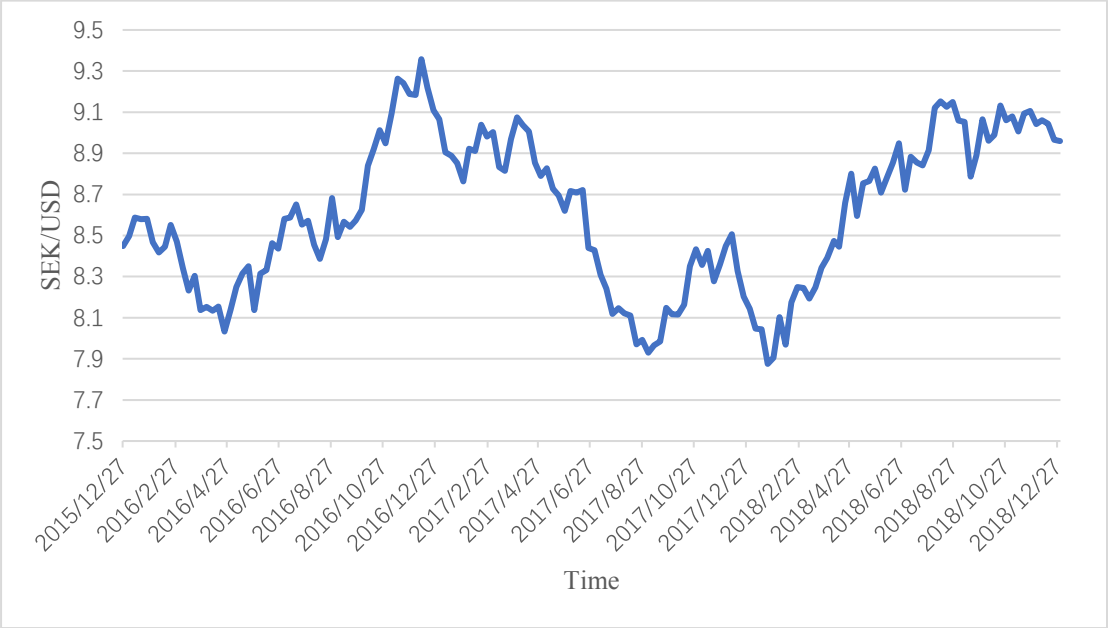
In this part, we analyze the historical weekly exchange rate SEK/USD which is from 2015 to 2018. Then we can use one appropriate model to predict the exchange rate for the next year 2019 according to the historical trend.

4.1.2.1 Historical trend of exchange rate SEK/USD

According to the situation, the data is also from December 28, 2015 to

December 31, 2018. The sample size is 158. And then, we can present the original data graphically.

Chart 4.3 Historical weekly data of exchange rate SEK/USD from December 28, 2015 to December 30, 2018



Source: https://www.investing.com/currencies/usd-sek-historical-data

From the Chart 4.3, we can get some information. From December 27, 2015 to December 27, 2018, the exchange rate has been volatility, it is not stable, it has risen sharply since March from April 30, 2016 and decreased from October 31, 2016. It is very similar with the tendency of the exchange rate of SEK/USD. During this period, compared with the US dollar, the Swedish krona was appreciated, and then depreciated. The maximum value is 9.3578, the minimum value is 7.9222.

From the tendency of exchange rate SEK/USD, we can find that the overall trend of the exchange rate SEK/USD is not obvious, the correlation coefficient of trend line is 0.0003, it is very small, and it is closed to zero.

According to the historical data, we decided to apply the geometric Brownian model to prediction the weekly exchange rate for the next year 2019.

4.1.2.2 Prediction of exchange rate SEK/USD

According to the theoretical part, we know that some steps are similar with the

steps of prediction of exchange rate SEK/USD.

We also suppose the length of interval is 1. At first, we have to calculate the continuous return which is based on the historical exchange rate according to the formula. We can calculate some related parameters based on the reference of the formula (2.10), such as the average value and standard deviation. Finally, we can create the table.

Table 4.2 Related parameters for prediction

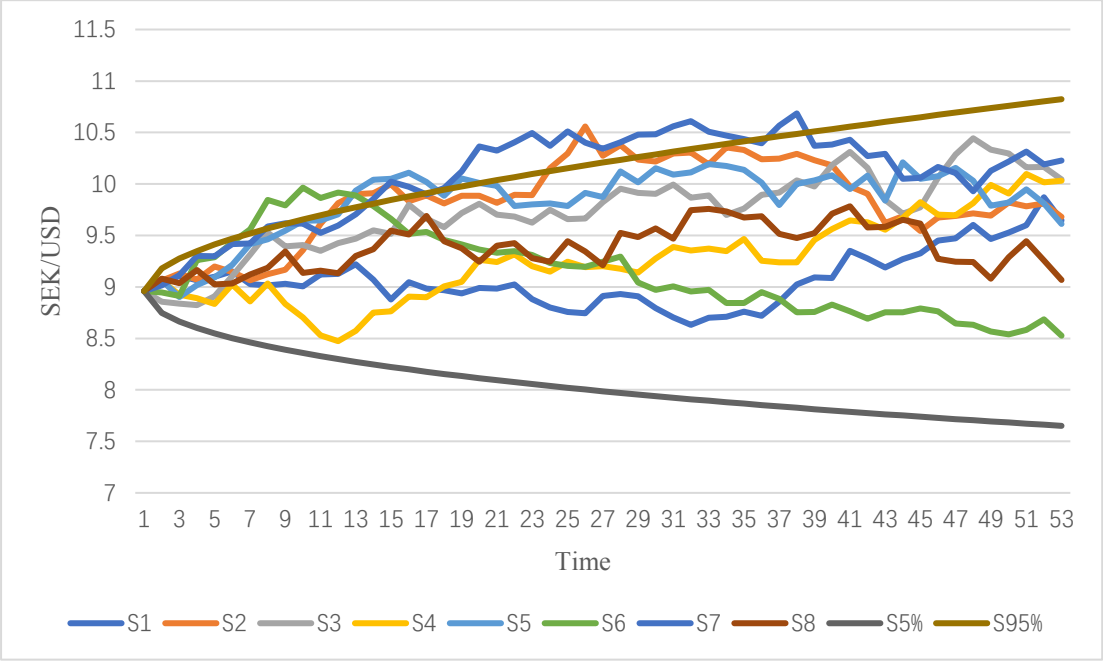
α (%)	σ	Δt	E_0	N
0.03%	0.01227	1	8.9593	157

From the Table 4.2, the mean value α is 0.03%, standard deviation σ is 0.01227, the time interval Δt is 1, the initial exchange rate of SEK/USD is 8.9593. the number of steps is 157. At Final, we can get the specific formula.

$$S_t = S_{t-1} \cdot exp(0.03\% + 0.01227 \cdot \tilde{z}) \tag{4.2}$$

We decided to generate 1000 scenarios. The next step is to generate random values $\tilde{z}$ from the standard normal distribution for each random scenario. The procedure can be done by the function in Excel. We should input the data. It is similar with the previous figure. Based on the formula (4.2), we can get the results.

Chart 4.4 Exchange rate SEK/USD evolution in 2019



There are 1000 independent scenarios and 52 steps for each scenario. We also just select the ten independent scenarios. The quantiles specify boundaries within which the exchange rate should randomly evolve. We can find that the changes of exchange rate SEK/USD are random.

4.2 Prediction of operating revenue

According to the principle of the Corporate Metric methodology, the main idea is to get the net earnings of the selected company, Electrolux Group. The net earning is the difference between the operating revenue and operating cost. It has two important components, operating revenue and operating cost. Therefore, we can calculate these two components separately.

In this part, the main objective is to prediction the operating revenue of Electrolux Group in 2019. Because the company sell the products in different countries, we need to consider the risk of exchange rates. Therefore, we need to calculate and predict the company's product sales and sales prices in different countries. Then we need to convert profits into national currency, Swedish Krona, according to the prediction which we have calculated.

4.2.1 Prediction of sales price in 2019

The main step is to calculate the average sales price and predict the annual price in different markets in 2019. We can divide it into two part to calculate the different price.

The first step is to calculate the average price of products. According to the principle of revenue calculation, we need to know the total revenue and the total sales volume in each year. And then we can divide the profit by the quantity to get the annual price. We selected the data from the past four years and calculate the average price in each year.

Table 4.3 Total revenue and quantity of products and price from 2015 to 2018

Year	Total revenue (SEK million)	Total quantity (SEK million)	Average price (SEK)
2015	123511	56	2205.554
2016	121093	60	2018.217
2017	120771	58	2082.259
2018	124129	59	2103.881

In this table, the first two columns are known data. The average price can be calculated which is based on the historical data from 2015 to 2018. From the result, we can find the average price rose during these years. Combined the actual situation of the company, the tariff policy has changed in some regions. It influences the sales of the company's products in the region, for example, the United States has increased tariffs, and it influence the price and the sales volume in American markets. And we can see that the average price increased. And we can briefly predict that average price will be about two thousand Swedish kronor.

We need to predict average price in 2019 which is based on the principle of simple average. According to the principle and formula (2.24) and formula (2.25) of this method, we need to calculate the amount of relative change of annual average price between the two years, and then we calculate the average, and we can get four value of relative change, which is expressed in K. Based on the average value of relative changes, we can calculate the average price in 2019.

Table 4.4 Average price of appliance in 2019

Year	Average price (SEK)	K
2015	2205.554	
2016	2018.217	-0.08494
2017	2082.259	0.031732
2018	2103.881	0.010384
Average		-0.01427
2019	2073.85	

From the table, we can find that the average price is 2073.85 Swedish kronor.

Because it is just estimated value, it is calculated by the total operating revenue and total quantity annually sold, and the unit which we calculated is national currency, Swedish kronor, we need to convert the average price into different currency, it includes the dollar and euro.

In the annual report of Electrolux Group, and we can get average annual exchange rate SEK/EUR and exchange rate SEK/USD. We also can use the same way to predict the exchange rate SEK/EUR and exchange rate SEK/USD in 2019. At final, we can calculate average price in Europe market and the price in American market next year.

Table 4.5 Annual exchange rate SEK/EUR and annual exchange rate SEK/USD

Year	SEK/EUR	SEK/USD
2015	9.35	8.4
2016	9.45	8.58
2017	9.74	8.54
2018	10.26	8.7

In the annual report, it has the annual exchange of SEK/EUR and annual exchange of SEK/USD. In these four years, they have same trend, the tendency of exchange rate is increasing, in the last year, the exchange rate of SEK/EUR is 10.26, the exchange rate of SEK/USD is 8.7.

According to the tendency and result of annual exchange rate, we can make the conclusion that the Swedish krona is appreciating for euro and dollar.

We can use the data which includes two exchange rates in the last year 2018 and average price in domestic country, Swedish kronor in 2019 to calculate the price in Europe market and American market. Then we can create the table.

Table 4.6 Average price in Europe market and American market in 2019

	Europe market	American market
Price	2073.85 SEK	2073.85 SEK
Exchange rate	10.26	8.7
Price	202.13 EUR	238.374 USD

From the table, the price in Europe market is about 202 euro, the price in

American market is about 238 dollars. At final, we get the average price in different markets in 2019.

4.2.2 Prediction of the sales volume in 2019

The main goal is to predict the sales volume in 2019, includes the sales volume in different country. We can collect the historical data of sales volume of products in different markets. According to the business of Electrolux Group, we divide the market into three parts, Europe market (EM), American market (AM) and Swedish market (SM). We can choose the data for the previous four years, from 2015 to 2018, and calculate.

Table 4.7 Sales volumes in different markets from 2015 to 2018 (Units: million)

	European Market	American Market	Swedish Market	TOTAL
2015	20.72	32.48	2.8	56
2016	24.6	32.4	3	60
2017	22.62	31.9	3.48	58
2018	21.24	34.22	3.54	59

Source: https://www.electroluxgroup.com/en/

From the table, we can get the sales volume of the company. We can find that, in the past four years, total sales have changed little, the Average annual sale is about 60 million. From the result, we can find that the company sells more in American markets, it includes some areas, for example, the company sell products in North America, sell for core appliances in the U.S. all major appliances, including microwave ovens and home-comfort products, the demand of these market was flat.

From the table, it is about 30 million which sold in American market, and about 20 million appliances which sold to Europe. It just sold about 3 million appliances in Sweden.

We can get each proportion of quantity in each currency which sold in last four years.

Table 4.8 The proportion of quantity of product which sold in last four years

Year	European Market	American Market	Swedish Market	Total
2015	37%	58%	5%	100%
2016	41%	54%	5%	100%
2017	39%	55%	6%	100%
2019	36%	58%	6%	100%

In the table, we calculate the proportion in each market, it can more intuitively find that the US market accounts for the largest proportion. The average proportion quantity of products sold in American market is closed to 56%. The average proportion of quantity of products sold in Europe market is closed to 38%. The average proportion of quantity of products sold in Sweden market is closed to 6%. It is smallest number and flat, compared with others, the quantity of appliances sold abroad was not stable, it is fluctuating, because the market demand of core appliance in Europe was decreased and the market demand of core appliance in American was increased. It explained that the company mainly sells electrical appliances abroad.

According to the quantity of sold product in each market in last four years, we can use the same way to predict the average quantity of sold product in each market in 2019. It can be predicted according to the simple average method, which is based on the formula (2.24) and formula (2.25). Then we can create the table.

Table 4.9 The prediction of quantity of sold product in each market in 2019

Year	EUR	k	USD	k	SEK	k
2015	20.72		32.48		2.8	
2016	24.6	0.187259	32.4	-0.00246	3	0.071429
2017	22.62	-0.08049	31.9	-0.01543	3.48	0.16
2018	21.24	-0.06101	34.22	0.072727	3.54	0.017241
		0.015254		0.018277		0.08289
2019	21.56		34.84		3.83	

Based on the data of quantity of sold product in different area, we can calculate the average quantity of sold product in different markets in 2019. And the unit of

quantity is million. According to simple average method, we calculate that in the next year, the quantity of product in Europe market will be about 21.56 million, it will have 34.84 million products which sell in American market. The company will sell 3.83 million appliances in Sweden.

4.2.3 Prediction of the operating revenue in 2019

In the first two subsections, we have calculated the average price in each market and the quantity of product which will sell in 2019. The step is to get the operating revenue in each market and then calculate the sum.

Firstly, we should calculate the quarterly operating revenue in each market.

The formula of operating revenue is equal to quantity of product multiply the average price.

We are able to collect the data of the annual quantity of product and the average price in each currency. Finally, we can calculate the quarterly operating revenue in different markets.

Table 4.10 The quarterly operating revenue for each market in 2019

	European Market	American Market	Swedish Market
Quantity (annual)	21.564	34.84545	3.833431
Price	202.13	238.3736	2073.85
Quantity (quarterly)	5.391	8.711363	0.958358
Operating revenue (quarterly)	1089.68	2076.559	1987.49

In the table, we get the quarterly quantity of product which will sell to each market in the next year. And then we calculate the quarter quantity according to the annual quantity. The unit of quantity of product is million. Finally, we get the operating revenue in each market. The quarterly operating revenue in Europe market is 1089.68 million euro, quarterly operating revenue in American market is 2076.56 million dollar, quarterly operating revenue in Europe market is 1987.49 million Swedish Krona. We have got the quarterly operating revenue in each market.

The assumption assumes that two exchange rates can influence the operating

revenue of the selected company. We need to consider the impact of two different currencies on operating revenue. According to the different prices of product in different markets, we transferred to the domestic currency, Swedish Krona. And then we can get quarterly operating revenue with the same unit, then we get the operating for each quarter by summing up with the national currency.

In the first part of prediction of exchange rate of SEK/EUR and exchange rate SEK/USD, we separately generated one thousand independent scenarios for exchange rate evolution. We evaluated these two exchange rates for 52 weeks. We have to convert the weekly data into quarterly data. We divided 52 weeks into four parts, and one month have 13 weeks, then we can calculate the average value of thirteen weeks. We can use this result as a quarterly exchange rate.

In our situation, quarterly operating revenue (OP) of each quarter is formulated by the sum of the quarterly operating revenue in three markets. There are three important parameters, Q, p and E.

In our case, Q is the quantity of product which will sell in each quarter. And p is the price in each market, these two parameters can get the operating revenue in quarter and E is the relative exchange rate of market with each quarter. Then we can calculate the result of quarterly operating exchange.

We can select the first scenario of exchange rate SEK/EUR and exchange rate SEK/USD. And we can calculate the quarterly exchange rate.

For the first scenario, the quarterly exchange rates in first quarter can be calculated the average value of 13 weekly exchange rate, then we can calculate the operating revenue in the first quarter for the first scenario.

The relative value which we need to use separately are quarterly revenue, quarterly exchange rate SEK/EUR and exchange rate SEK/USD. For the first scenario, we can generate the table.

Table 4.11 The operating revenue and exchange rate in first quarter, 2019

	EUR	USD	SEK
Operating revenue	1089.681	2076.599	1987.49
Exchange rate	10.162	8.849	

From the table, we can know that, in first quarter, the exchange rate SEK/EUR is 10.162, the exchange rate SEK/USD is 8.849, the operating revenue in Europe market is 1089.681 million euro, the operating revenue in American market is 2076.599 million dollars, the operating revenue in Sweden market is 1089.681 million Krona. Then we just transfer the operating revenue of different currency into the same currency, Swedish Krona.

For the first scenario, we can calculate in first quarter like that:

$$Operating\ revenue_{EM}^{1} = 10.89681 * 10.162 = 11073.213\ SEKm$$

$$Operating\ revenue_{UM}^{1} = 2076.599 * 8.849 = 18375.1007\ SEKm$$

The unit of operating revenue is million Swedish Krona, and we have three operating revenues in first quarter, from the table, we can know the quarterly operating revenue and sum together, we can get the total operating revenue in the first quarter.

$$OR_{q1}^{1} = 11073.21 + 18375.1007 + 1987.49 = 31435.8\ SEKm$$

According to the process of calculation of quarterly operating revenue, we can separately calculate operating revenue in other quarters.

$$OR_{q2}^{1} = 11725.11 + 19931.37 + 1987.49 = 33643.97\ SEKm$$

$$OR_{q3}^{1} = 11932.64 + 20298.06 + 1987.49 = 34218.20\ SEKm$$

$$OR_{q4}^{1} = 12058.73 + 20442.22 + 1987.49 = 34488.44\ SEKm$$

And now, the operating revenue in each quarter have been calculated, for the first scenario, we can get the value of operating revenue in a whole year.

$$OR_{total}^{1} = 31435.8 + 33643.97 + 34218.2 + 34488.44 = 133786.4\ SEKm$$

For the first scenario, we get the total operating revenue which is 133786.4 million Swedish Krona. According to same process, we can calculate total operating revenue for 1000 independent scenarios. We can generate the table which we just select

ten independent scenarios. The unit is million Swedish Krona.

Table 4.12 Ten estimated quarterly operating revenue in 2019

Operating revenue	Quarterly operating revenue in 2019				
$SEKm$	Q1	Q2	Q3	Q4	SUM
Scenario 1	31435.80	33643.97	34218.20	34488.44	133786.4
Scenario 2	31293.88	32015.76	31897.27	31516.17	126723.1
Scenario 3	31816.57	31874.37	31826.88	31773.01	127290.8
Scenario 4	30956.15	31192.43	30389.78	31097.11	123635.5
Scenario 5	32093.16	31828.25	30621.30	31374.36	125917.1
Scenario 6	32257.19	31274.73	31904.28	30445.11	125881.3
Scenario 7	31656.90	31490.18	30831.99	30216.76	124195.8
Scenario 8	32373.24	33296.39	34977.69	36379.17	137026.5
Scenario 9	32879.27	34533.72	35035.67	35057.49	137506.2
Scenario 10	31892.07	31689.66	31517.20	32283.28	127382.2

In the table, we have got the ten independent scenarios of operating revenues in 2019. In fact, we have already calculated 1000 independent values of operating revenues.

4.2.4 Frequency analysis of the operating revenue

In the last part, we have generated 1000 independent scenarios of operating revenues in 2019. According to value of operating revenue in quarter, we can make the frequency analysis of operating revenue in each quarter.

According to the principle of frequency analysis, we need to know some parameters which we have to use. In the frequency analysis, we need to set some interval.

The formula which is used in frequency analysis follows as:

$$\text{Interval} = \frac{MAX-MIN}{Number\ of\ interval} \tag{4.3}$$

In the formula, *MAX* means the maximum value, *MIN* means the minimum

value, in Excel, we can use the function "*MAX*" and "*MIN*" to calculate the value. In the process, we can set that the number of intervals is 20, and we can calculate the interval.

For 1000 different scenarios, we can calculate the interval of operating revenue in each quarter, we create the relative table based on the formula (4.3).

Table 4.13 Relative parameters of frequency analysis in each quarter, 2019

	Q1	Q2	Q3	Q4
MIX	29739.02	27925.971	26775.061	25963.739
MIN	34193.683	36418.423	40508.28	43232.977
Difference	4454.6631	8492.4521	13733.22	17269.238
Number of intervals	20	20	20	20
Interval	222.73316	424.62261	686.66098	863.46189

There are some relative parameters which we use in frequency analysis, the difference means that the difference between maximum value and minimum value. The unit of interval is million Swedish Krona.

According to relative parameters which we got, we can create 20 different intervals. Then we can make the frequency. And we chose some area which we will get the result, then use the function "*FREQUENCY*" in Excel, the function has two important parameters, *"data_array"* and *"bins_array"*. We need to add the origin data which is operating revenue, the second is the interval which we have calculated. According to the function, we can get different frequency for each interval. Because we generate 1000 scenarios, at final, the total frequency is 1000. For each frequency of each quarter, we can calculate the probability of each quarter which calculated the frequency divided by 1000.

Table 4.14 Frequency and probability of operating revenue in first quarter, 2019

Interval	Frequency	Probability
29739.02	1	0.10%
29961.753	2	0.20%
30184.486	6	0.60%
30407.219	14	1.40%
30629.953	21	2.10%
30852.686	35	3.50%
31075.419	58	5.80%
31298.152	74	7.40%
31520.885	107	10.70%
31743.618	128	12.80%
31966.352	139	13.90%
32189.085	98	9.80%
32411.818	97	9.70%
32634.551	79	7.90%
32857.284	68	6.80%
33080.017	33	3.30%
33302.751	23	2.30%
33525.484	10	1.00%
33748.217	4	0.40%
33970.95	0	0.00%
34193.683	3	0.30%
SUM	1000	100.00%

In the chart, we can get the frequency and probability in first quarter, it is easy to see the results clearly. The unit is million Swedish Krona. From the specific data, we can find that there is a lot of data concentrated in the interval 31966.352~32189.085. In this interval, it has 139 values. The probability is about 13.90%.

Table 4.15 Frequency and probability of operating revenue in second quarter, 2019

Interval	Frequency	Probability
27925.971	1	0.10%
28350.594	0	0.00%
28775.216	8	0.80%
29199.839	11	1.10%
29624.461	12	1.20%
30049.084	28	2.80%
30473.707	46	4.60%
30898.329	88	8.80%
31322.952	116	11.60%
31747.574	122	12.20%
32172.197	133	13.30%
32596.82	101	10.10%
33021.442	93	9.30%
33446.065	77	7.70%
33870.687	59	5.90%
34295.31	50	5.00%
34719.933	24	2.40%
35144.555	14	1.40%
35569.178	12	1.20%
35993.8	4	0.40%
36418.423	1	0.10%
SUM	1000	100.00%

In the chart, we can get the frequency and probability in second quarter. The unit also is million Swedish Krona. From the specific data, we can find that there is a lot of data concentrated in the interval 32172.197~32596.82. In this interval, it has 133 values. The probability is about 13.30%.

Table 4.16 Frequency and probability of operating revenue in third quarter, 2019

Interval	Frequency	Probability
26775.06	1	0.10%
27461.72	2	0.20%
28148.38	4	0.40%
28835.04	10	1.00%
29521.70	39	3.90%
30208.37	61	6.10%
30895.03	107	10.70%
31581.69	152	15.20%
32268.35	157	15.70%
32955.01	138	13.80%
33641.67	104	10.40%
34328.33	90	9.00%
35014.99	67	6.70%
35701.65	43	4.30%
36388.31	16	1.60%
37074.98	7	0.70%
37761.64	0	0.00%
38448.30	1	0.10%
39134.96	0	0.00%
39821.62	0	0.00%
40508.28	1	0.10%
SUM	1000	100.00%

In the chart, we can get the frequency and probability in third quarter. The unit also is million Swedish Krona. From the specific data, we can find that there is a lot of data concentrated in the interval 32268.35~32955.01. In this interval, it has 157 values. The probability is about 15.70%.

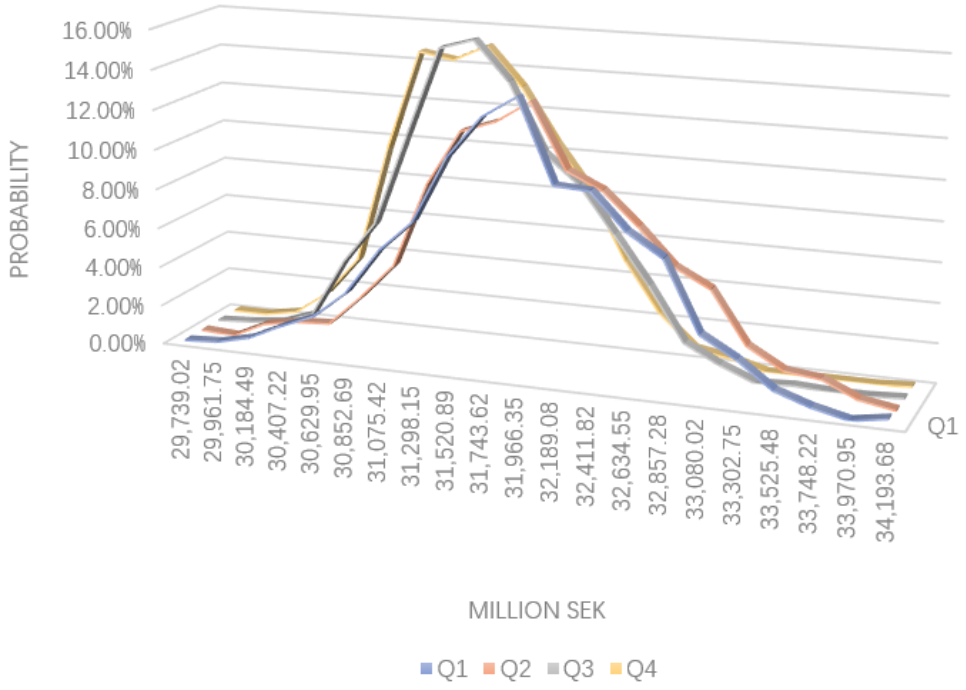
Table 4.17 Frequency and probability of operating revenue in fourth quarter, 2019

Interval	Frequency	Probability
25963.73904	1	0.10%
26827.20093	1	0.10%
27690.66282	4	0.40%
28554.12471	16	1.60%
29417.58659	36	3.60%
30281.04848	96	9.60%
31144.51037	146	14.60%
32007.97226	143	14.30%
32871.43415	151	15.10%
33734.89604	132	13.20%
34598.35792	105	10.50%
35461.81981	82	8.20%
36325.2817	49	4.90%
37188.74359	24	2.40%
38052.20548	8	0.80%
38915.66737	5	0.50%
39779.12925	0	0.00%
40642.59114	0	0.00%
41506.05303	0	0.00%
42369.51492	0	0.00%
43232.97681	1	0.10%
SUM	1000	100.00%

In the chart, we can get the frequency and probability in fourth quarter. The unit also is million Swedish Krona. From the specific data, we can find that there is a lot of data concentrated in the interval 32871.43415~33734.89604. In this interval, it has 151 values. The probability is about 15.10%.

Combining the four tables, we are able to get a probability distribution for each quarter of 2019.

Chart 4.5 Probability distribution of operating revenue in each quarter, 2019



From the chart, we can know the probability distribution of operating revenue from 1000 scenarios in each quarter. The trend of this distribution is similar to the trends of normal distribution, we can find that there is a lot of data concentrated in the interval 31000~33500. It has higher probability than others. The frequency is more than 400, The probability is more than 40%.

4.3 Prediction of total operating cost

The aim is to calculate and estimate total operating cost in 2019, the value is based on the historical data. and then, we can calculate net operating income in 2019.

We have to collect the historical data in annual report of Electrolux Group, and create the income statement for the past five years. From the annual report, we can get the accounting process.

Table 4.18 Income statement for the past five years (Unit: million Swedish Krona)

Income statement	2014	2015	2016	2017	2018
Net sales	112143	123511	121093	120771	124129
Cost of goods sold	-91564	-99913	-95820	-95222	-100908
Gross operating income	20579	23598	25273	25549	23221
Selling expenses	-11647	-12719	-13208	-12897	-12986
Administrative expenses	-5454	-6019	-5812	-5550	-5101
Other operating income	176	67	218	328	1054
Other operating expenses	-73	-2186	-197	-23	-877
Other operating income/expense	103	-2119	21	305	177
Operating income	3581	2741	6274	7407	5310

Source: https://www.electroluxgroup.com/en/annual-reports-27641/

From the table, we can get some important information, net sales mean total operating revenues. There are some items which belong to expense which will reduce the final net operating income. They include cost of goods sold, selling expenses, administrative expenses and other operating expenses. The item which will add is other operating income.

Cost of goods sold (COGS) is the cost of acquiring or manufacturing the products that a company sells during a period, so the only costs included in the measure are those that are directly tied to the production of the products, including the cost of labor, materials, and manufacturing overhead. It explains that the expense is related the product which the company sells, the more products the company sells, the higher the profit, and the higher the cost of goods sold. It is related to total operating revenue. We can calculate cost of goods sold in 2019, which is based on the ratio of cost of sales to operating revenue.

The principle of selling expenses is very similar with the principle of cost of goods sold. It is related to total operating revenue. We can calculate selling expenses in 2019, which is based on the ratio of cost of sales to operating revenue.

When we estimate these two items, we have to calculate the ratio related to operating revenue.

In our case, the formula of ratio shows as:

$$\text{Ratio} = \frac{Item_t}{operating\ revenue_t} \tag{4.4}$$

In formula, this item refers to item which is related to operating revenue in *t* period. In the income statement of the selected company, the items include cost of good sold and selling expenses. We can calculate the ratio for the past five years and calculate the average value of the ratios.

Table 4.19 Ratio calculation for the past five years

	2014	2015	2016	2017	2018	Average
Cost of goods sold	81.65%	80.89%	79.13%	78.85%	81.29%	80.04%
Selling expenses	10.39%	10.30%	10.91%	10.68%	10.46%	10.59%

From the table, we can get the ratio for the past five years, the average value is the average for the past five year, the average value of ratio for cost of goods sold is 80.04%, the average value of ratio for selling expenses is 10.59%.

Then we can calculate these two items according to ratio and total operating revenue which we have estimated before. For example, in the first scenario, total operating revenue is 133786.4 million Swedish Krona.

We can calculate COGS and SE for the first scenario.

$$COGS^1_{2019} = 80.04\% * \ 133786.4 = 107082.63 \text{ SEKm}$$

$$SE^1_{2019} = 10.59\% * \ 133786.4 = 14167.980 \text{ SEKm}$$

For the first scenario, in 2019, cost of goods sold is 107082.63 million Swedish Krona, selling expenses is 14167.980 million Swedish Krona.

In the income statement, we have other three items which have to estimate. They separately are administrative expenses, other operating income and other operating expenses. The calculation of these three items is different with calculation which we have made before.

For administrative expenses, we can calculate the average value which refers to administrative expenses in 2019.

The administrative expenses can be calculated as:

$$\mathrm{AE}_{2019} = \frac{5454 + 6019 + 5812 + 5550 + 5101}{5} = 5587.2\ SEKm$$

AE means the administrative expenses in 2019, the five value is administrative expenses for the past five years. After the calculation, we can get the result. In 2019, the administrative expenses will be 5587.2 million Swedish Krona.

For the other operating income and other operating expenses, we can use weighted average method.

The calculation is based on the formula (2.23).

Wi refers to the weight of the i items, *xi* refers to the value of the i items, in our calculation, we have five years, and we can set the different weight for different year. and we can calculate the value in 2019.

Table 4.20 The weights and two relative items from 2014 to 2018

	2014	2015	2016	2017	2018
Weight	1	2	3	4	5
Other operating income	176	67	218	328	1054
Other operating expenses	-73	-2186	-197	-23	-877

According to the weight and value of other operating income other operating expenses in each year, we can calculate the results of other operating income other operating expenses in 2019.

We can get the calculation of other operating income (OOI) and other operating expenses (OOE).

$$\mathrm{OOI}_{2019} = \frac{176 * 1 + 67 * 2 + 218 * 3 + 328 * 4 + 1054 * 5}{1 + 2 + 3 + 4 + 5} = 503.1\ SEKm$$

$$\mathrm{OOE}_{2019} = \frac{73 * 1 + 2186 * 2 + 197 * 3 + 23 * 4 + 877 * 5}{1 + 2 + 3 + 4 + 5} = 634.2\ SEKm$$

We have calculated the result, in 2019, other operating income is 503.1 million

Swedish Krona, other operating expenses is 634.2 million Swedish Krona.

Finally, we can calculate the total operating cost according to the relative items which we have calculated.

The formula of total operating cost (TOC) follows as:

$$\mathrm{TOC}_t^i = \mathrm{COGS}_t^i + \mathrm{SE}_t^i + \mathrm{AE}_t + \mathrm{OOE}_t - \mathrm{OOI}_t \quad (4.5)$$

In the formula, *i* means *i-th* scenario. *t* means at time *t*. *COGS* refer to cost of goods sold, SE refers to selling expenses, AE refers to administrative expenses, OOE refers to other operating expenses, OOI refers to other operating income.

According to the formula (4.5), we can calculate the value of total operating cost in 2019. For the first scenario, we can calculate the result.

$$TOC_{2019}^1 = 107082.6 + 14167.98 + 5587.2 + 634.2 - 503.1 = 126964.6$$

For the first scenario, the total operating cost is 126964.608 million Swedish Krona. We can use the same way to calculate the other total operating cost.

4.4 Prediction of net operating income

The main objective is to get net operating income of the selected company in 2019. We have estimated the operating revenue (TOR) and operating cost (TOC). And then we can calculate the difference between them. We can get the value of net operating income in 2019.

$$\text{Net operating income}_{2019}^i = \mathrm{TOR}_{2019}^i - \mathrm{TOC}_{2019}^i \quad (4.6)$$

In the formula, *i* means *i-th* scenario. We have generated 1000 scenarios of total operating revenues and total operating cost, from the difference between them, we will predict 1000 different scenarios of net operating incomes in 2019. There is a lot of data, therefore, we just selected the first ten scenarios and create the table.

Table 4.21 Ten scenarios of net operating income in 2019 (Unit: million Swedish Krona)

	TOR	TOC	NOI
Scenario 1	133786.416	126964.608	6821.808
Scenario 2	126723.082	120563.338	6159.744
Scenario 3	127290.828	121077.868	6212.960
Scenario 4	123635.483	117765.148	5870.335
Scenario 5	125917.068	119832.874	6084.194
Scenario 6	125881.307	119800.465	6080.842
Scenario 7	124195.835	118272.977	5922.858
Scenario 8	137026.499	129900.990	7125.509
Scenario 9	137506.153	130335.685	7170.468
Scenario 10	127382.214	121160.688	6221.526

In the table, we can get these results in 2019. Finally, we got 1000 different results. For the net operating income, we can make the frequency analysis and illustrate the results graphically. From the table, we can make a simple conclusion, the higher the total operating revenue, the higher the total operating cost. Based on the formula (4.3), we need to calculate some parameters.

Table 4.22 Relative parameters of frequency analysis for net operating income

MIN	MAX	Difference	Number of intervals	Interval
4862.773	8570.146	3707.373	20	185.369

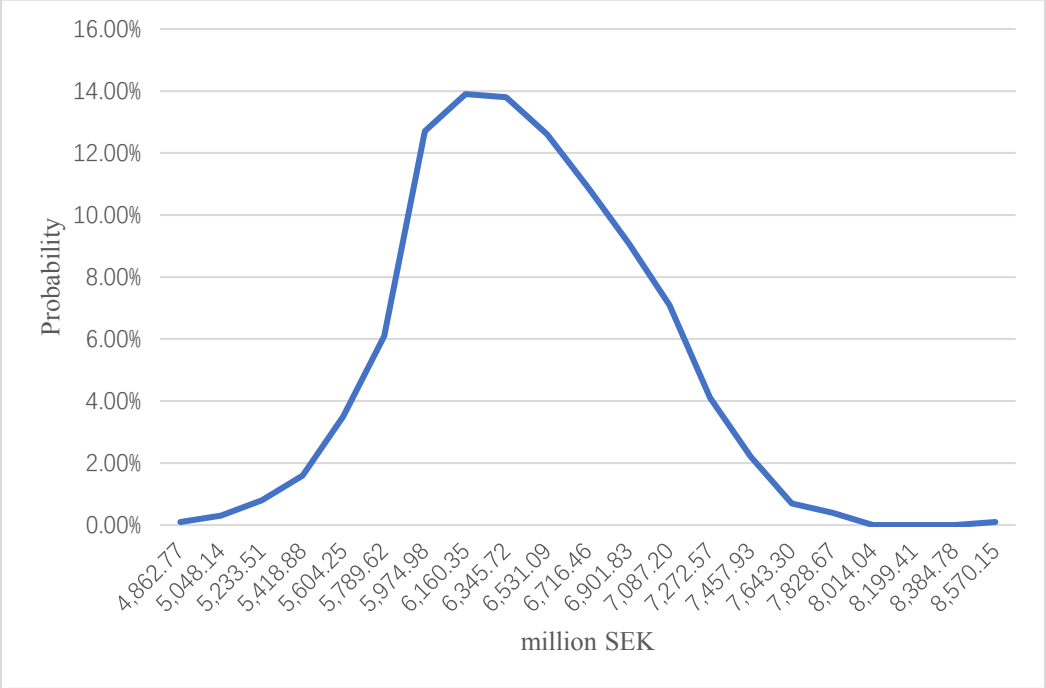
In the table, we get some information. In 1000 different scenarios, the maximum is 8570.146 million Swedish Krona, the minimum value is 4862.773. Then we calculated the difference between them is 3707.373. We suppose that it has 20 intervals, we can calculate the spacing is 185.369 in each interval. We can use "*FREQUENCY*" function to get each frequency in each interval. Based on 1000 different scenarios, we calculate each probability in each interval.

Table 4.23 Frequency and probability distribution of net operating income in 2019

Interval	Frequency	Probability	Cumulative
4862.7729	1	0.10%	0.10%
5048.1415	3	0.30%	0.40%
5233.5102	8	0.80%	1.20%
5418.8788	16	1.60%	2.80%
5604.2474	35	3.50%	6.30%
5789.6161	61	6.10%	12.40%
5974.9847	127	12.70%	25.10%
6160.3533	139	13.90%	39.00%
6345.722	138	13.80%	52.80%
6531.0906	126	12.60%	65.40%
6716.4592	109	10.90%	76.30%
6901.8279	91	9.10%	85.40%
7087.1965	71	7.10%	92.50%
7272.5651	41	4.10%	96.60%
7457.9338	22	2.20%	98.80%
7643.3024	7	0.70%	99.50%
7828.6711	4	0.40%	99.90%
8014.0397	0	0.00%	99.90%
8199.4083	0	0.00%	99.90%
8384.777	0	0.00%	99.90%
8570.1456	1	0.10%	100.00%
SUM	1000	1	

From the table, we can find that it has higher numbers of values which are concentrated in interval, 6160.3533 ~ 6345.722. In this interval, the frequency is 139, the probability is 13.9%. From overall view, the net operating income between 5974.9847 million SEK to 6901.8279 million SEK has high probability which is more than 60%. According to frequency and probability in each interval, we can make the graph of probability distribution of net operating income in 2019

Chart 4.6 Probability distribution of net operating income in 2019



From chart, we can know the probability distribution of net operating income which we predicted in 2019. The trend is similar with the trend of normal distribution. We can get the highest probability in the interval, 6160.35 ~ 6531.09 million SEK.

According to a series of calculations, we can make a conclusion that there is higher probability that the operating revenue in 2019 is more than 124129 million Swedish Krona which is total operating revenue in 2018. There is also higher probability that the net operating income in 2019 is more than 5310 million Swedish Krona which is the net operating income in 2018.

4.5 Sensitivity analysis of net operating income

We have predicted net operating income in 2019. Because the company sells the products in different markets, and get the different currency, we have to turn them into a unified currency, the consolidated financial statements are presented in Swedish krona, we convert them into Swedish krona. In this whole process of prediction of net operating income, it is based on the simulation of the two related factors, exchange rate SEK/EUR and exchange rate SEK/USD, according to stochastic model. These key factors can influence net operating income.

According to the principle of sensitivity analysis, we can change relative parameters of key factors, through changing the parameters, we observe the impact of changes in the two exchange rates on net operating income in 2019.

Combined with the previous process of predicting exchange rates, we suppose that the change of continuous return of two exchange rates will influence the net operating income of company.

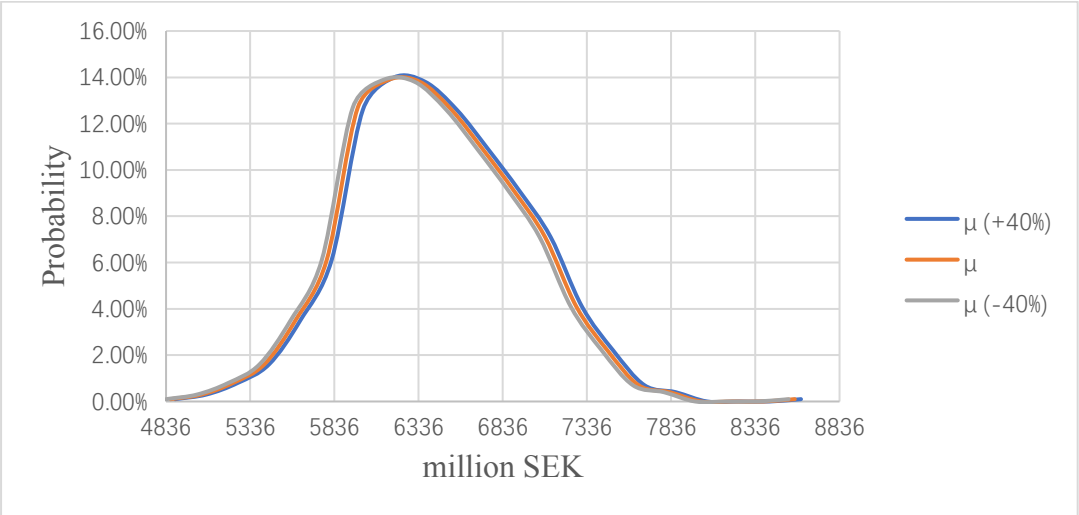
When we change the continuous return, the average return will change, thereby changing the exchange rate and net operating income. We can generate the table about the changed value of relative parameters for two exchange rates which is based on the specific formula (4.1) and formula (4.2). We suppose that continuous return will decrease or increase by 40%.

Table 4.24 Relative parameters for two exchange rates

	SEK/EUR		SEK/USD	
	μ (+40%)	μ (-40%)	μ (+40%)	μ (-40%)
μ	0.10%	0.04%	0.05%	0.02%
σ	0.0077	0.0077	0.01227	0.01227
α	0.09%	0.04%	0.04%	0.01%

In the table, we have got new value of relative parameters. The changed value will influence the value of net operating income.

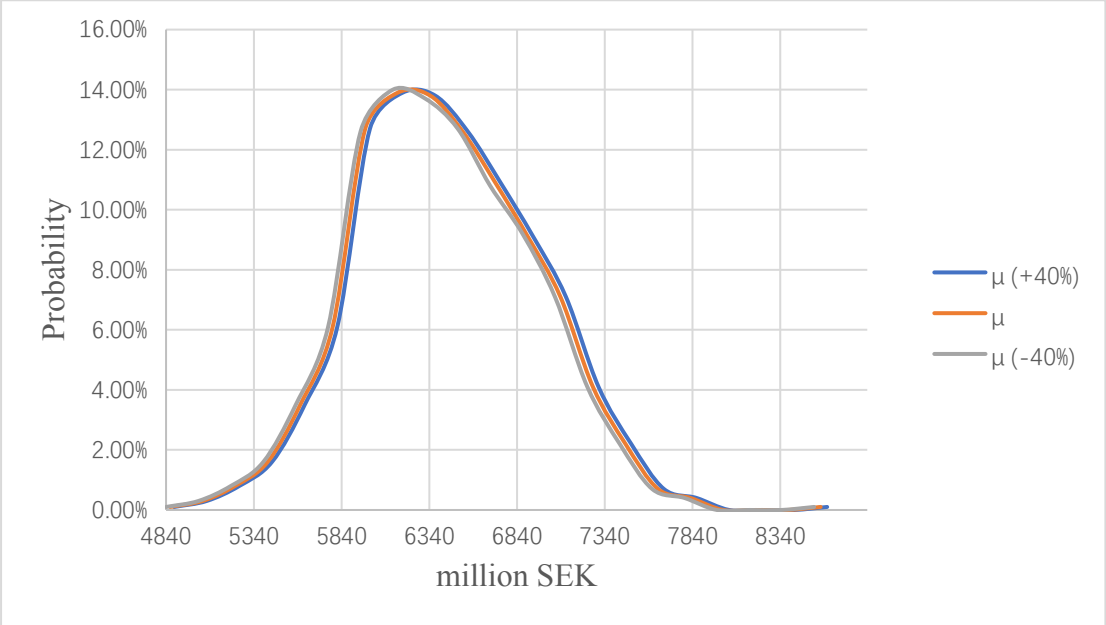
Chart 4.7 Sensitivity analysis of probability distribution of the net operating income (change in exchange rate SEK/EUR)



Through the same steps of probability distribution, we can get new net operating income and make the probability distribution of net operating income in 2019.

In the chart, we can see the probability distribution of net operating income in the case of changing in exchange rate SEK/EUR. We change the value of continuous return; we can get new probability distribution of net operating income. If the exchange rate SEK/EUR goes up, the probability distribution of the net operating income moves to the right; to the opposite, if the exchange rate SEK/EUR goes down, the probability distribution of the net operating income moves to the left of the original one.

Chart 4.8 Sensitivity analysis of probability distribution of the net operating income (change in exchange rate SEK/USD)



In the chart, we can find that if exchange rate SEK/USD goes up, probability distribution of the net operating income moves to the right; if exchange rate SEK/USD goes down, probability distribution of net operating income moves to the left. Compared with the probability distribution of SEK/EUR, we can find the change is very small, and we can make a conclusion that the sensitivity is very similar in the case of changing in exchange rate SEK/EUR and exchange rate SEK/USD. The sensitivity of exchange rate SEK/USD is little sensitive according to the interval and probability.

5. Conclusion

Electrolux Group is Swedish multinational home appliance manufacturer, headquartered in Stockholm. It is a large company. The company mainly produces appliances. The core markets are Western Europe, North America, Australia, New Zealand. It has the exchange rate risk, which is related to exchange rate SEK/EUR and exchange rate SEK/USD.

The main objective is to make the prediction of the probability distribution of the net operating income of Electrolux Group in 2019 based on the simulation of the two important factors. The prediction is based on data from the previous five years.

The calculation can be divided into three parts. Firstly, it is calculation of total operating revenue. We predict the weekly exchange rate SEK/EUR and exchange rate SEK/USD in 2019 based on the geometric Brownian motion. And we generate 1000 scenarios. From the chart, two exchange rate which we evaluate will be changing a lot in 2019. Based on the evaluation of two exchange rate, we get 1000 scenarios of total operating revenue, and the probability distribution of operating revenue in each quarter, 2019.

The second part is prediction of total operating cost. From the income statement, we can find the company has higher costs of goods sold and selling expenses. These already account for 90% of total operating revenue. The evolution is based on the simple average method. And we can calculate 1000 scenarios of operating costs and get the results.

The third part is calculation and prediction of probability distribution of the net operating income in 2019.

From the probability distribution of quarterly operating revenue, there is a lot of data concentrated in the interval 31000~32000 million Swedish Krona. There is higher probability that the operating revenue in 2019 is more than 124129 million Swedish Krona which is total operating revenue in 2018.

From the probability distribution of the net operating income, we can make the conclusion that there is higher probability that the net operating income in 2019 is more

than 5310 million Swedish Krona which is the net operating income in 2018.

From the sensitivity analysis, the sensitivity of exchange rate SEK/EUR is similar with the sensitivity of exchange rate SEK/USD. The exchange rate SEK/USD is little sensitive for the net operating income of the company. If two key exchange rates go up, the probability distribution of the net operating income moves to the right of the original one, to the opposite, it will move to the left.

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List of Abbreviations

Q	Quantity of product the company sold
μ	Average logarithmic price change
σ	Standard deviation
St	Market price at t period
$\tilde{z}$	Random value from the standard normal distribution
TOR	Total operating revenue
TOC	Total operating cost
NOI	Net operating income
COGS	Cost of goods sold
EUR	Euro
USD	United States Dollars
SEK	Swedish krona

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Herewith I declare that

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Ostrava dated 26.04.2019

涂澜慧 Tu Lanhui

Student's name and surname

List of Annexes

Annexes

Annex 1 Income Statement (Unit: million Swedish Krona)

Income statement	2014	2015	2016	2017	2018
Net sales	112143	123511	121093	120771	124129
Cost of goods sold	-91564	-99913	-95820	-95222	-100908
Gross operating income	20579	23598	25273	25549	23221
Selling expenses	-11647	-12719	-13208	-12897	-12986
Administrative expenses	-5454	-6019	-5812	-5550	-5101
Other operating income	176	67	218	328	1054
Other operating expenses	-73	-2186	-197	-23	-877
Other operating income/expense	103	-2119	21	305	177
Operating income	3581	2741	6274	7407	5310
Financial items, net	-584	-640	-693	-441	-423
Income after financial items	2997	2101	5581	6966	4887
Taxes	-755	-533	-1088	-1221	-1081
Income for the period	2242	1568	4493	5745	3805